

SRB CRITICAL ITEMS LIST

SUBSYSTEM: RECOVERY

ITEM NAME: NASA Standard Detonator, NSD

PART NO.: SEB 26100094-201

FM CODE: A02

ITEM CODE: 40-04-03

REVISION: BASIC

CRITICALITY CATEGORY: 1

REACTION TIME: Immediate

NO. REQUIRED: 1

DATE: March 1, 2002

CRITICAL PHASES: Final Countdown,
Boost, Separation

SUPERCEDES: March 31, 1998

FMEA PAGE NO.: C-46

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SHEET 1 OF 4

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CN 044

FAILURE MODE AND CAUSES: Premature operation caused by:

- o High Temperature
- o Shock/Vibration
- o Electromagnetic Interference
- o Electrostatic discharge
- o Increased sensitivity due to contamination

FAILURE EFFECT SUMMARY: Premature operation of the NSD during final countdown will cause impact of the frustum assembly and/or nose cap with the ET or Orbiter resulting in loss of vehicle, mission and crew. Premature operation during boost or separation will cause abnormal aerodynamic forces leading to loss of vehicle control. The prematurely deployed frustum assembly and/or nose cap will impact other vehicle elements causing loss of vehicle, mission and crew.

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RATIONALE FOR RETENTION:

A. DESIGN:

- o The NSD is GFE supplied by Johnson Space Center (JSC) and consists of a NASA Standard Initiator (NSI) (SEB26100001) with a backup ring welded to the body of the NASA Standard Detonator. The NSI is controlled by specification SKB26100066 and drawing SEB26100001. The NSD design is controlled by drawing SEB26100094 and specification SKB26100097. Detonator uses RDX and lead azide explosive mix for hi-temp protection. NSI meets EMI compatibility per MC999-0002. Firing circuitry consists of twisted shielded pairs for Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) protection. Pyro Initiator Controller (PIC) is two failure tolerant for protection against an erroneous output.

- o The NSD is able to withstand a model lightning flash without jeopardizing the strength or function required to safely continue the mission per Nation Space Transportation System (NSTS)-07636. The NSD is electrically bonded to the SRB structure through its mating pyrotechnic component. The electrical bonding resistance is required to be less than 2.5 milliohms across each interface per NSTS 07636.

The NSD will withstand 25,000 volt electrostatic discharge between both pins shorted together and the NSD body per JSC specification SKB26100066.

- o Electromagnetic control measures are defined by MSFC Electromagnetics Effects Control Plan 10PLN-0067.
- o The NSD will not ignite when the bridgewire is subjected to a dc current of 1 amp for 5 minutes or a dc power of 1 watt for 5 minutes within the temperature range of 300^oF to -260^oF per JSC specification SKB26100066.
- o Lightning protection requirements are specified by NSTS 07636, Lightning Protection Criteria Documents.
- o Qualification Tests: Detonator originally qualification tested for Apollo in 1965. Additionally qualaified for orbiter umbilical attach per certification requirement (CR) 45-565330 and with the 3/4 inch frangible nut autoignition test verified no fire when exposed to 340^oF for 1 hour (maximum expected temperature is ambient). NSI has been qualified to a no fire condition when subjected to 1 watt/1 amp for 5 minutes. CR-45-114-0018-0003, CR-45-453-0021-0009; SKB26100097.
- o Design Verification Test: NSI and wiring was tested for close proximity RFI susceptibility prior to Apollo-Soyuz Test Project (ASTP).
- o The NSI passed exposure to test currents of 40 kiloamperes. The PIC/cable/NSI combination tested with no failures to at least 640 volts during lightning test on the shuttle SRB nozzle severence system. L&T report 629.

B. TESTING:

VENDOR RELATED TESTING

- o Acceptance Tests: Acceptance tests include tensile test (3 coupons from same heat treat), examination of product (weight, workmanship, finish, dimensions, construction, and certified M&P). Bridgewire resistance and 50 volt insulation resistance test for NSI. Neutron and X-ray (Presence of explosive mix, no foreign material, and proper assembly). Leakage (1×10^{-6} CC per sec helium), and weight (Pyro charge and all other cartridge parts weighed pre- and post-assembly. Totals must be within specified tolerance). CR-45-453-0021-0009, ATP 5044; SKB26100097. (Contamination)

KSC RELATED TESTING

- o Integrated Power "ON" Stray Voltage Test is checked per OMRSD File II, Volume 1, requirement number S00000.140. (EMI, Electrostatic Discharge)
- o Integrated Power "OFF" Stray Voltage Test is checked per OMRSD File II, Vol. 1, requirement number S00GEN.635. (EMI, Electrostatic Discharge)
- o GO PIC test with live pyrotechnics per OMRSD File II, Volume 1, requirement no. S00000.410. (EMI, Electrostatic Discharge)
- o GO PIC test with live pyrotechnics during launch countdown per OMRSD File II, Volume 1, requirement no. S00FA0.015. (EMI, Electrostatic Discharge)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTION

- o Receiving Inspection:
Raw material is verified by inspection to assure specific shuttle requirements are satisfied. (Contamination)
- o Contamination Control:
Contamination control and corrosion protection processes and storage environments are monitored and verified by inspection. (Contamination)
- o Assembly/Installation:
Selected manufacturing/assembly steps are identified by NASA and quality assurance and verified by Government Inspection Mandatory Inspection Points (MIPS). (All Failure Causes)
- o Nondestructive Evaluation:
Parts are X-rayed and N-rayed to verify correct assembly and presence of all detail parts and explosives. X-rays and N-rays are reviewed by vendor, DCAS, and NASA quality and engineering. (Contamination)
- o Critical Processes:
All manufacturing processes such as welding, plating, heat treating, passivation and anodizing are verified by inspection. (Electrostatic Discharge)

o Storage:

Storage environment verified by inspection. (Contamination/High Temperature)

KSC RELATED INSPECTION

- o Receiving inspection verifies that the NSDs have been flight certified by JSC as required by NSTS 08060 per OMRSD File V, Volume 1, requirement no. B000FL.002. (All Failure Causes)
- o Verification that insulation resistance test is acceptable per OMRSD File V, Volume 1, requirement no. B000FL.001. (Electrostatic Discharge)
- o Inspection for damage and contamination per OMRSD File V, Volume 1, requirement no. B000FL.001. (Contamination)
- o Bonding between all metallic faying surfaces is verified per OMRSD File V, Volume 1, requirement no. B75000.020. (Electrostatic Discharge)
- o Shelf life is verified by SPC Quality per OMRSD File II, Vol. 3, Table no C00CA0-040-000 (Increased Sensitivity due to Contamination)

D. FAILURE HISTORY:

- o Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE:

- o Not applicable to this failure mode.